REMARKS

Summary of Office Action

Claims 1-10 are pending.

Claims 1-10 have been rejected under 35 U.S.C. 102 (b) as anticipated by Koemtzopoulous et al. U.S. Patent No. 6,101,479 ("Koemtzopoulous") or in the alternative under 35 U.S.C. 103 (a) as obvious from the same reference.

Applicants' Reply

Applicants have amended Claim 1 to clarify the invention, and respectfully traverse the prior art rejections.

Claim 1

Applicants' invention relates to a method for reliable determination of "clean," "sharp" or "abrupt" i.e., unambiguous, endpoints during plasma etch cleaning of processing chambers. Prior art methods do not provide unambiguous determinations of cleaning endpoints. As noted in the Background section of the specification, this may be at least in part because the prior art methods measure or monitor inappropriate process parameters, i.e. parameters that do not exhibit a clear unambiguous signature of the cleaning endpoints. For example, U.S. Patent No. 4,602,981 describes measurement of RF voltage and U.S. Patent No. 5,812,403 describes measurement of light absorption, neither of which provides a distinct or unambiguous signature of the endpoints. (See e.g., specification ¶¶ [0008]-[0010]).

In appplicants' invention, according to claim 1, involves measurement of the DC bias voltage between "ground and a decoupling electrode of the plasma generator disposed within the processing chamber." This parameter provides a distinct unambiguous signature of the endpoint of the plasma etch cleaning. (See e.g., Specification ¶¶ [0023] and [0024], and FIG. 2).

In contrast to appplicants' invention, Koemtzopoulos describes only indirect and ambiguous determinations of endpoints. (See e.g., Koemtzopoulos FIG. 2). Koemtzopoulos describes a vacuum processing reactor, i.e. a chamber 10 whose walls are grounded, a workpiece holder 12, and a metal horn 14, which serves as an electrode. (See FIG. 1). Horn 14 and workpiece holder 12 are connected to RF power source 32 via a transducer 50 and a matching network 34. Koemtzopoulos mentors a value of DC bias voltage by measuring n external tap voltage (i.e., at tap 43 of resistive voltage divider 45). The tap 43 is positioned outside the process chamber.

Koemtzopoulos' tap voltage measurement does not provide a unambiguous determination of the cleaning endpoint. (See Koemtzopoulos, FIG. 2). Koemtzopoulos considers chamber 10 to be clean when two criteria are met, i.e. after one of the electrical parameters (e.g., tap voltage) associated with the plasma impedance has been **stabilized** and a fore line pressure sensed by sensor 20 has been **stabilized**. The plasma impedance is considered to be stabilized when the value of at least one of capacitors 36 and 38 or the filtered bias voltage at tap 43 has **stabilized** (See col. 6, lines 11 - 21). The bias voltage is considered to be stabilized when the tap voltage

reaches a local maximum after having a positive time rate of change (1) or have a constant value of more than a predetermined interval (2). (See col. 6, lines 26 - 31).

Koemtzopoulos' FIGS. 2 and 3 show that the values of capacitors are stabilized after about 80 seconds. The horn bias voltage goes through a minimum approximately 30 seconds into the cleaning cycle. Then, the horn bias increases to a (a very flattened) local peak after approximately 80 seconds, after which the horn bias decreases very gradually or remains constant over a extended time period. (See col. 6, line 66 - col. 7. line 12). The FIGS. show that Koemtzopoulos fails to determine the claming endpoint unambiguously. Koemtzopoulos considers the work piece holder, horn etc. to be clean "when any one of the plots 60, 62 or 64 is stabilized" (See col. 7, lines 13 - 19). This method of endpoint determination is very inaccurate and ambiguous since it is not easy to unambiguously determine or decide a discrete point when a plot is stabilized.

In contrast to Koemtzopoulos, applicants' invention does not rely on some vague criteria of a "stable DC bias voltage". Applicants monitor the DC bias voltage directly between ground and a decoupling electrode of the plasma generator. This measurement parameter provides a clean and unambiguous cleaning process endpoint, which is defined by a predetermined (discrete) voltage point value of DC bias voltage (and not by some vague criteria of the DC bias voltage decreasing very gradually or remaining constant over some period of time). Applicants' FIG. 2 shows that DC bias voltage when measured directly between ground and a decoupling electrode of the plasma generator shows a very clear and sharp peak at the endpoint of the cleaning process.

Further, applicants' endpoint determination, unlike Koetmtzopoulos' method, does require measurements of additional parameters such as fore line pressure or capacitor values.

Accordingly, claim 1 is patentable over Koetmtzopoulos's for at least the foregoing reasons.

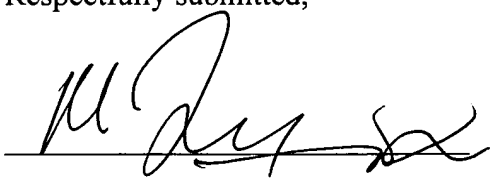
Dependent claims 2 -10

Claims 2-10, which depend from claim 1, are patentable for at least the same reasons that claim 1 is patentable as discussed above.

Conclusion

Applicants respectfully submit that this application is now in condition for allowance. Reconsideration and prompt allowance of which are requested. If there are any remaining issues to be resolved, the applicants request that the Examiner contact the undersigned attorney for a telephone interview.

Respectfully submitted,



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